REMARKS

The Examiner's attention to the present application is noted with appreciation.

In paragraph 2 of the Office Action, the Examiner rejected Applicant's claims for lacking sufficent support in the specification. The Examiner stated that "[c]ertian kind of phase-locking for the laser diodes seems to be needed in order to achieve [a coherent laser beam]". Applicant believes the specification is, in fact, fully enabling with respect to claims 1-4. The Examiner's assertion that some kind of "phase-locking for the laser diodes seems to be needed" is correct, as Applicant explained in the specification from page 1, line 30 to page 2, line 6. Although Applicant did not use the exact phrase "phase-locking" Applicant instead used the phrase "so that they become locked in their phase relations" (page 2, lines 4 & 6). As such, amended claims 1-4 are believed allowable over the Examiner's § 112 rejection.

In paragraph 5 of the Office Action, the Examiner stated several reasons why the claims failed to comply with 35 U.S.C. § 112 requirements. The claims have been amended to conform with current U.S. practice and it is believed that they now meet all requirements of § 112.

In paragraph 7 of the Office Action, the Examiner rejected claims 1 and 2 under 35 U.S.C. § 103(a) as being unpatentable over Roess in view of Ritter et al. The Examiner asserted that the disclosure of Ross shows all the limitations of the claims with the exception that it does not teach explicitly that the hologram is of a reflection mode. This is however not the only difference. The diode lasers according to the invention are placed in a diode array to support a high power laser, whereby the individual diodes are by nature unpredictable in frequency and phase. This requires that the hologram used be tailor-made to the particular properties of the diodes from the array.

This is not the case in Roess which only applies single diodes which have to be predictable in phase and frequency in view of the fact that Roess applies a hologram which shows a typical interference pattern based on the predictable behavior of the single diodes that Roess uses.

The further reference to Ritter does not result in the invention according to claims 1 and 2 in view of the fact that also in Ritter the use of high power diode arrays with the above-mentioned associated problems is not discussed.

The above remarks also support the patentability of claims 3 and 4, which were rejected by the Examiner, under 35 U.S.C. § 103 over Roess in view of Psaltis et al., in paragraph 8 of the Office Action.

Claims 3 and 4 concern a method for making a hologram which is to be used in the apparatus and method according to claims 1 and 2. The making of such a hologram is not taught by Roess nor Psaltis. Consequently, their combination cannot result in Applicant's invention according to claims 3 or 4.

The only reference to making a hologram that can be found in the disclosure of Roess is when Roess mentions that the hologram is created by superposing a spherical wave with a series of spherical waves from the various single resonators of the partial oscillators. This presupposes that the diodes have to be locked from the outset in order to start with beams or waves that are coherent (see Col. 2, line 49 of Roess).

In Roess, the hologram cannot be recorded using the same diodes as will be used in the final laser since these diodes are not yet phase-locked. Thus, according to Roess, even in the case of diode array consisting of many separate diode stripes, coherence is generally not present and any attempt to record a hologram following the teaching of Roess will fail due to the low coherence.

In the present invention, it is recognized that the initial phase locking, which is required for the recording of the correct hologram, must be induced in another way. Even very complex phase patterns such as emitted by a multitude of diodes in a diode array can be phase conjugated by application of a photorefractive crystal in a self-pumped configuration. In doing so, the crystal provides a common feedback to all the diodes in the diode array and phase locks them to a common frequency. This process will not start instantly. Since the diodes are initially unlocked, a random phase pattern is produced at first. This random pattern provides a fairly random feedback to the diodes. Eventually, however, one common mode prevails and all diodes lock to the dominant mode and thus become phase locked to each other. The self-pumped photorefractive crystal therefore acts as a self-organizing holographic phase-conjugating

reflector. This process provides the coherence required to record the interference pattern for the holographic reflector.

By recording the interference pattern between the locked diodes (locked through the feedback of the photorefractive crystal) and a reference beam (where the reference beam has the same high quality spatial phase pattern as the beam that will be traveling in the common part of the cavity once the hologram is in use) a recording is obtained that contains the information required to transform the light from the diodes into a common beam. This recording is only a record; it is not yet a hologram. This recording can be made into a (phase) hologram either by etching the recorded pattern into a surface (in the case of a surface relief hologram made from a surface recording) or by developing a photopolymer into a volume phase hologram (in the case of a volume recording).

Once the hologram is created, the photorefractive crystal has served its purpose and can be taken away. The feedback that is required to lock the diodes is now provided by the external mirror (#6). Since the hologram was recorded such that it transforms the light from the diodes into a beam that fits the external cavity, the mirror will provide feedback that is appropriate (i.e. the phase conjugate of the reference beam used for the recording). The reflection from the mirror which equals the phase conjugate of the reference beam will be reconstructed as the phase conjugate of the light froth the diodes and therefore feed back into the diodes.

In paragraph 8, the Examiner stated that it would be obvious to one skilled in the art that a self-pumped photorefractive crystal could be used to replace the hologram and external mirror used by Roess to obtain the feedback for the diodes. That may be so, but it is irrelevant; claims 3 and 4 relate to making the hologram. Claims 3 and 4 do not concern replacement of the hologram. Furthermore, in such a configuration, the crystal will provide the phase conjugate but there will no longer be an external cavity from which one can extract the high quality beam with the flat phase front that used to reside in the common part of the cavity. The light from the diodes is not transformed into the nice single coherent superposition of beams that one would like to extract but is directly converted to the phase conjugate and

sent back to the diodes. This provides the diodes with feedback and locks them to a common frequency but does nothing to improve their complicated spatial superposition.

The present invention eliminates the photorefractive crystal from the final laser. The crystal is only used for the recording of the appropriate hologram and is then removed. Current technology is such that each set of diodes is different. One area in which diodes differ is the "diode smile", a curvature of the diode array due to the curvature of the wafers on which they are created. This smile is unpredictable and would require adjusting the simulated diode array to fit every particular diode. Also, current diodes do not emit spherical waves or anything like spherical waves. They are already multi moded and will not lock if they are injected with only spherical waves. Locked diodes are known to emit "super modes" that consist of a complicated spatial pattern that is much more complicated than the addition of a number of spherical waves. In other words, the holograms proposed by Roess do not suffice. The case that Roess describes (and depicts in the drawing) of well separated diodes (that perhaps even run single frequency individually) might be amenable to his "spherical waves" approach for the hologram recording but for modern high power diode arrays it will not work. The making of a hologram according to claims 3 and 4, which is then capable of being used for the generation of a coherent laser beam based on the emission of a series of diode lasers that are placed in a diode array, is therefore new and non-obvious over Roess and any other art made of record.

In view of the above amendments and remarks, it is respectfully submitted that all grounds of rejection and objection have been avoided and/or traversed. It is believed that the case is now in condition for allowance and same is respectfully requested.

If any issues remain, or if the Examiner believes that prosecution of this application might be expedited by discussion of the issues, the Examiner is cordially invited to telephone the undersigned attorney for Applicant at the telephone number listed below.

Also being filed herewith is a Petition for Extension of Time to October 4, 2004, the next business day, with the appropriate fee. Authorization is given to charge payment of any additional fees required, or credit any overpayment, to Deposit Acct. 13-4213.

Respectfully submitted,

By: _____
Jeffrey D. Myers, Reg. No. 35,964
Direct line: (505) 998-1502

PEACOCK, MYERS & ADAMS, P.C.
Attorneys for Applicant(s)
P.O. Box 26927
Albuquerque, New Mexico 87125-6927

Telephone: (505) 998-1500
Facsimile: (505) 243-2542

Customer No. 005179

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